Global Particle Identification Software

mCglProjection
mCglPid
mCglPidEval

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Goals

For each Reconstructed Track (dCglParticle):

- Provide PID Primitives
  - Mass^2 for:
    - TOF
    - EMCal timing
    - EMCal Kinetic Energy
    - TEC γβ
    - RICH ring PMT mean timing
  - Error in Mass^2 (Propagated)

- Provide list of Possible PID's
  - GEANT ID's, Confidence Level, Probability

- Flag Tracks with large disagreement between detector PID info

- First Pass Screening on electron candidates
  - Bit Pattern Flag with 5 electron criteria

mCglProjection

Input:

- 1-to-1 corresp. with dCglTrack
- Pointers to Hit Positions from:
  - PC2, PC3, TEC, MVD

Algorithm:

- Do y vs. x fit from at least 2 points of:
  - TEC in, TEC out, PC2, PC3
- Do z vs. r fit from:
  - PC2 and PC3 or
  - MVD and PC2 or PC3
- Project to PC2, PC3, RICH, TOF, EMCal
  - Idealized "Fixed-R" detectors
  - except TOF (thanks H. Sako)
- Extrapolate MomRec Flight Distance

Output:

- At detector radii:
  - 3-position, "Direction Cosines" e.g.
  - dx/dr, Flight Distance

mCglPid

Input:

- Reconstructed Momentum (dCglParticle)
- Charge Polarity (dCglParticle)
- Flight Distances (dCglProjection)
- TOF time (dTofReconstructed)
- EMCal time, E (dEmcClusterLocal)
- TEC γβ[2], dE/dx (dTecPID)
- RICH Npmt, chi2, rdisp,time (dCrkPid)
- BBC TimeZero (dBbcOut)
- Parameters (dCglPidPar)

Algorithm:

Loop over dCglParticle:

- Calculate M^2 and error:
  TOF,EMCal E, EMCal time, TEC γβ
- Compare M^2 values for large χ^2
- Calculate weighted mean M^2 and error
- For Possible PID hypotheses (based on charge state):
  Calculate χ^2/d.o.f and Conf. Level
- Check for Electron Cuts
- Check for Antibaryon Cuts

Output--dCglPid

PID Primitives

M^2 and errors

PID hypotheses

nparticles, particle[10],probability[10], confidence[10]

Information Flags

prob_flag (detector disagreements)
elec_flag (electron candidate cuts)
info_flag (what detectors were used)

Pointers to Detector Output Tables

Usage Modes:

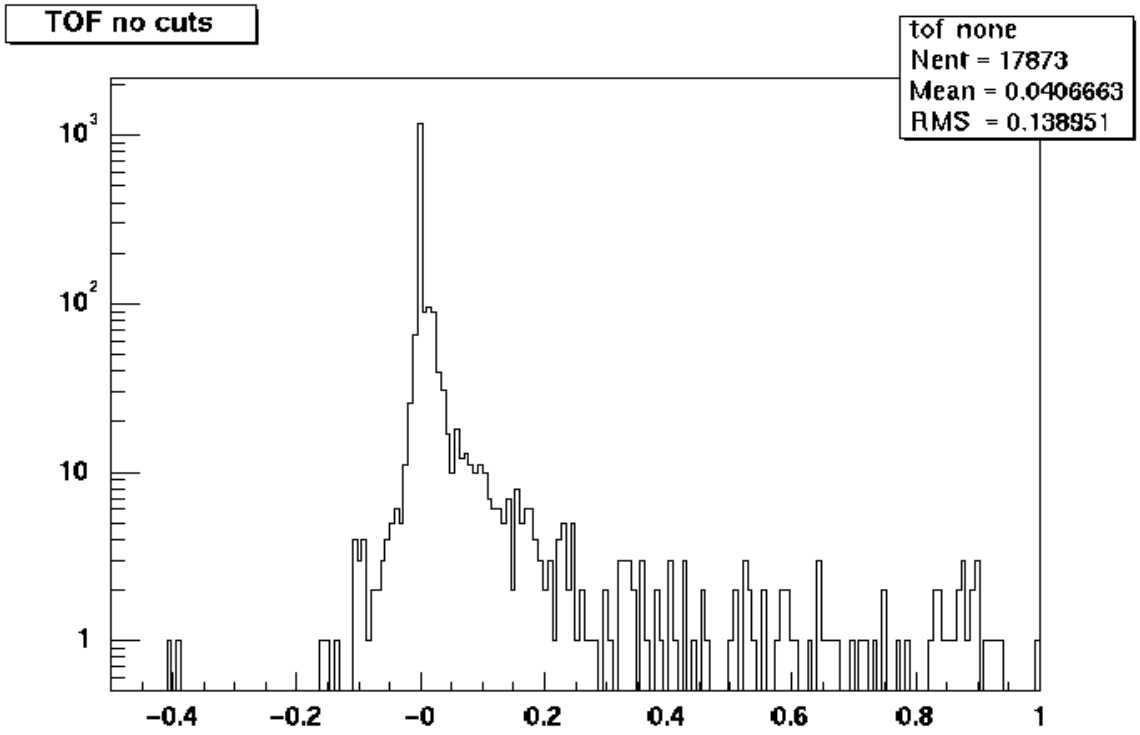
"Hands On" --plot M^2, define cuts

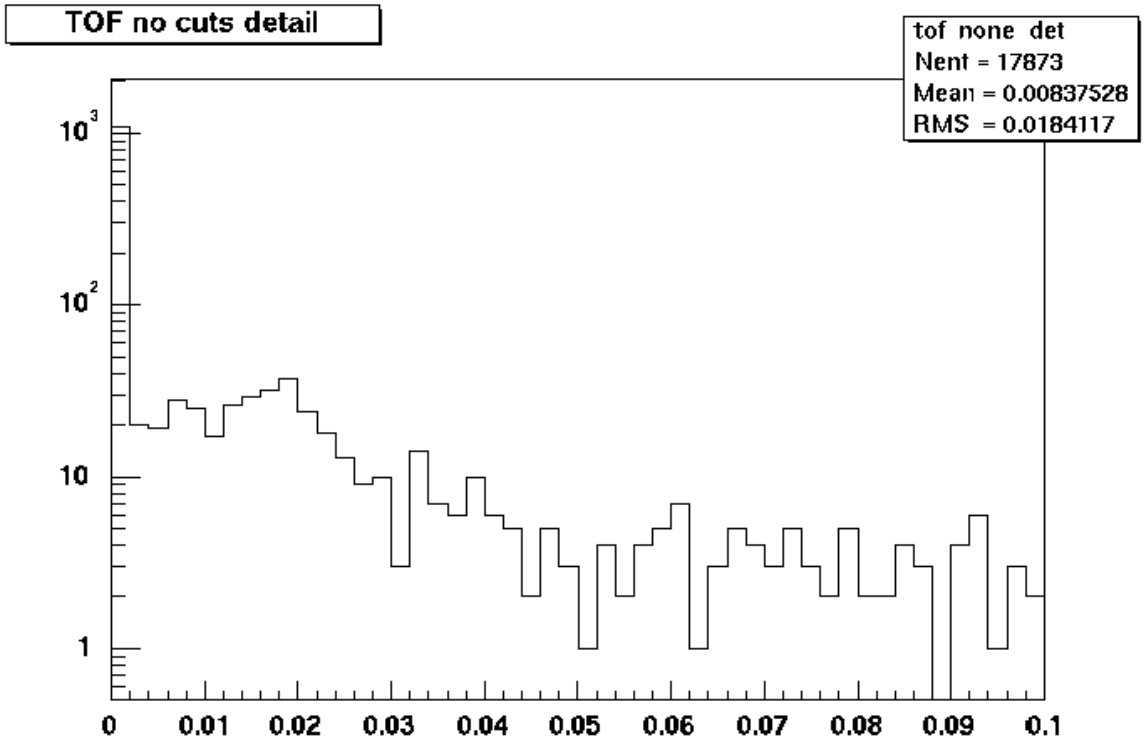
"Statistical"--use Confidence Levels, plot M^2

"Electron Screening"

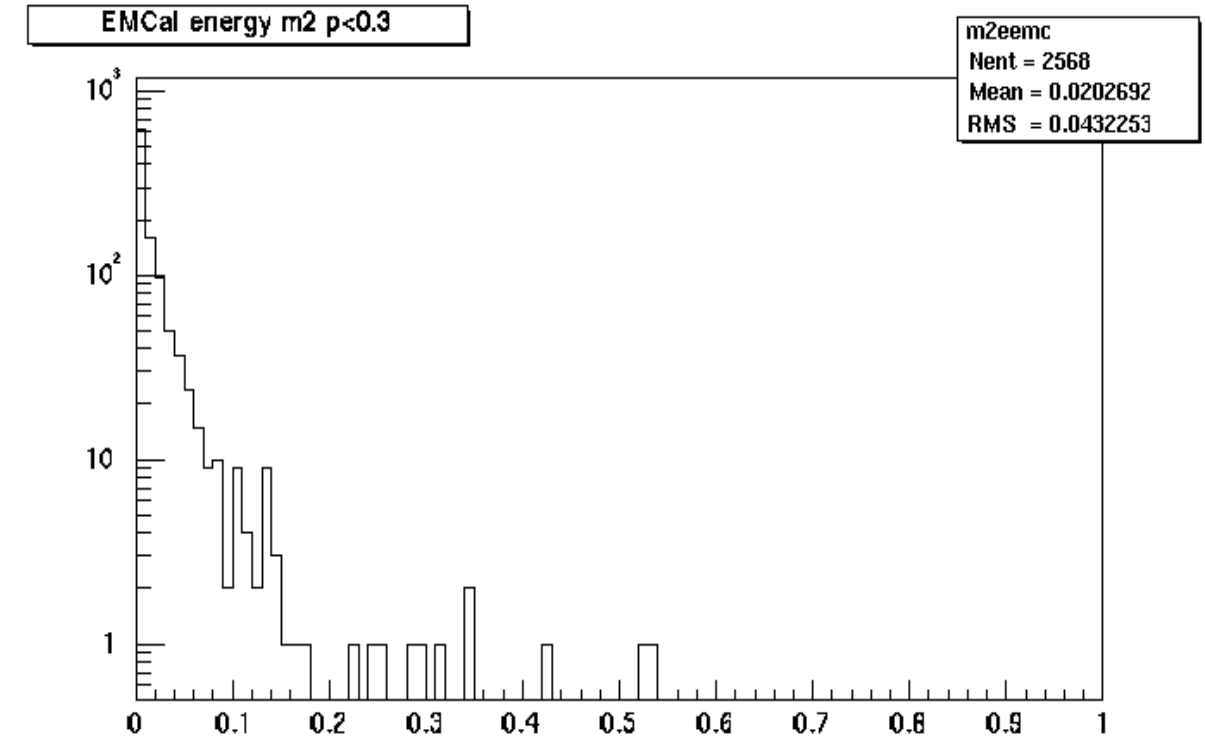
"Debugging"--use PID info to improve codes

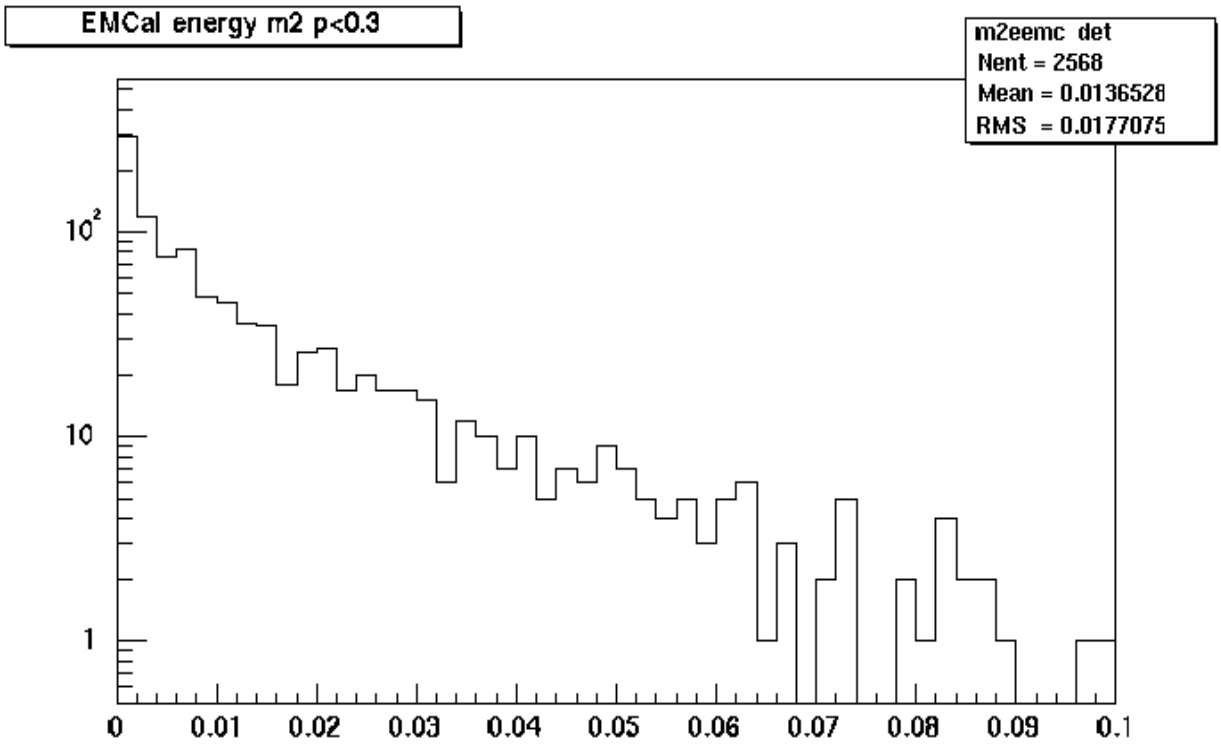
Mass^2 from TOF



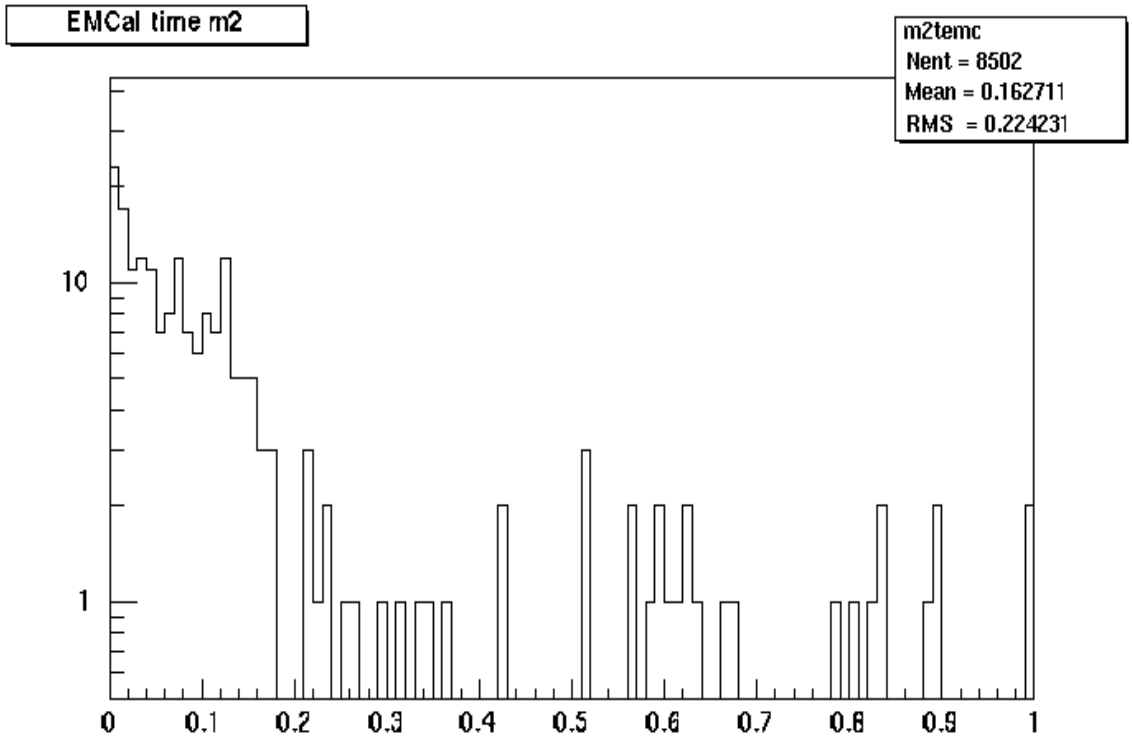


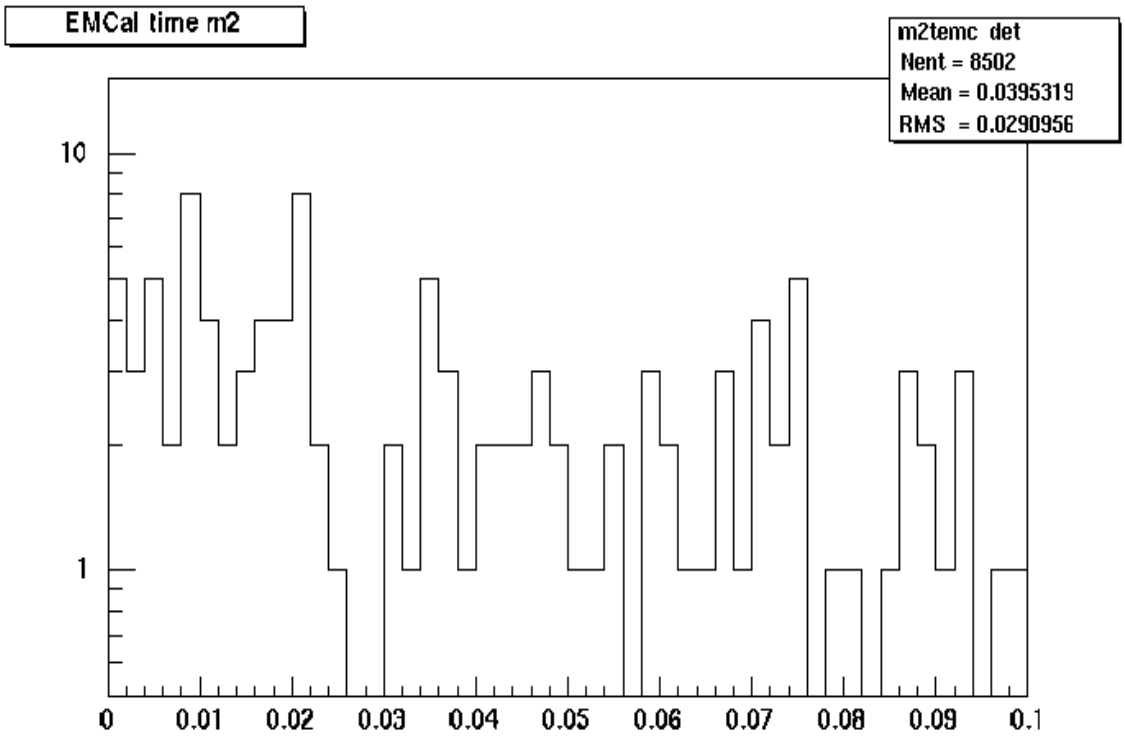
Mass^2 From EMCal Energy



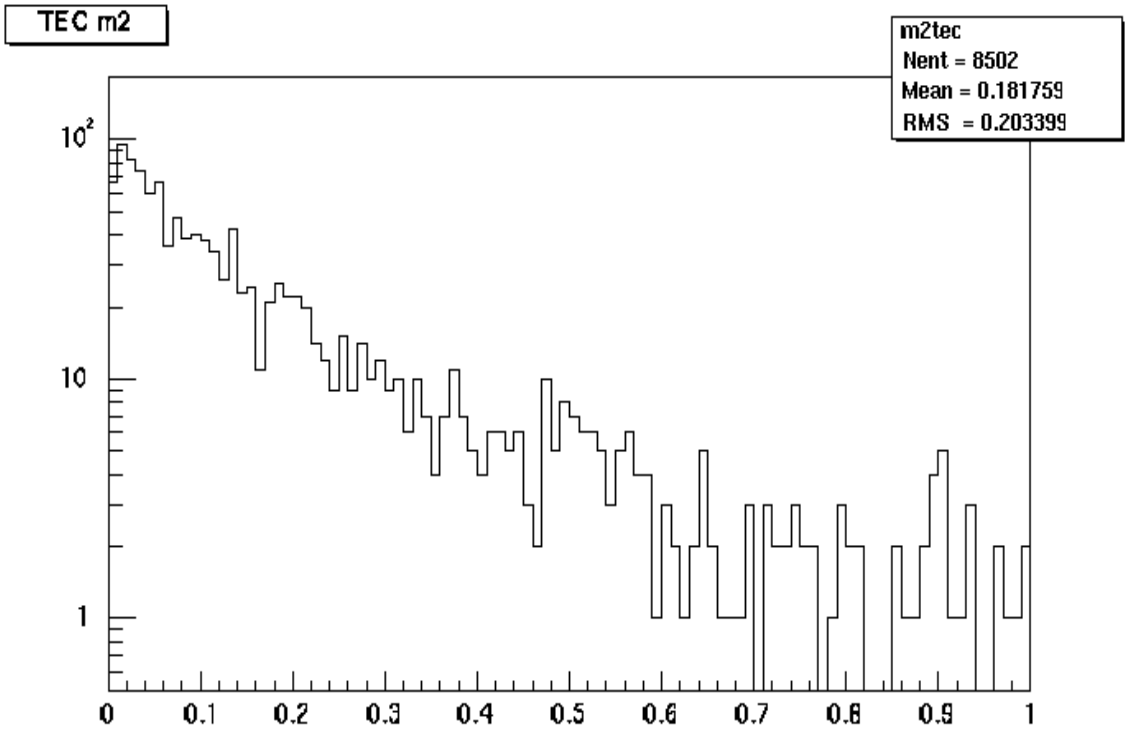


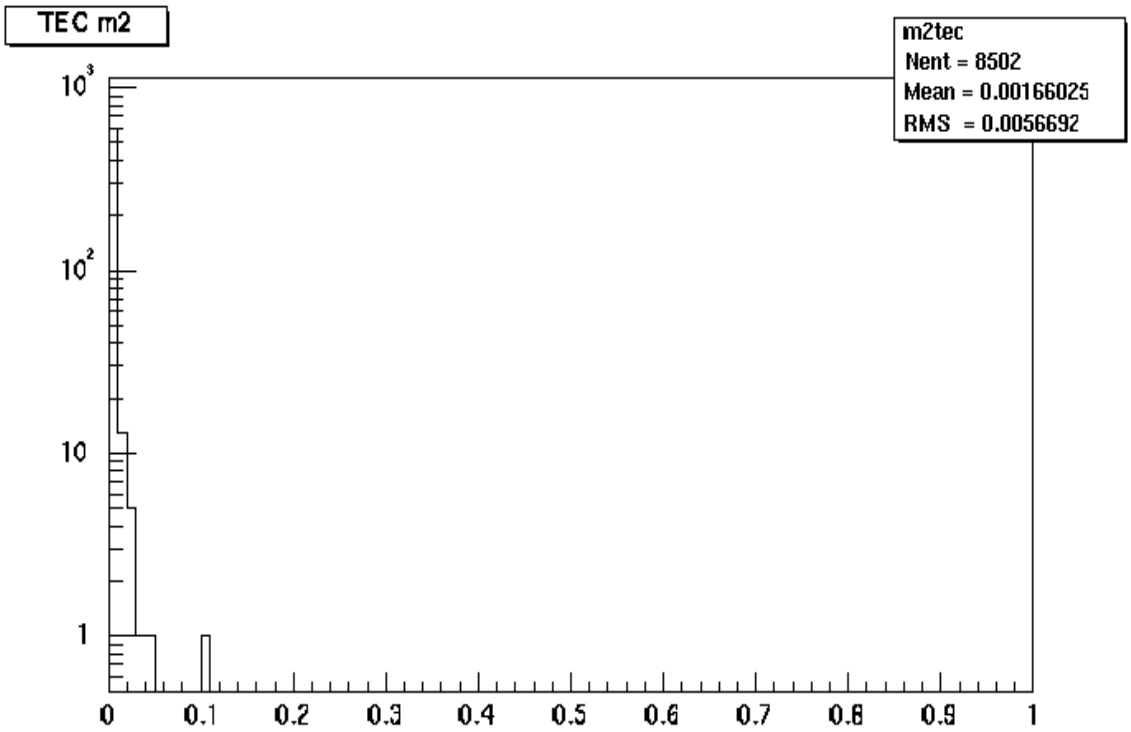
Mass^2 From EMCal Timing



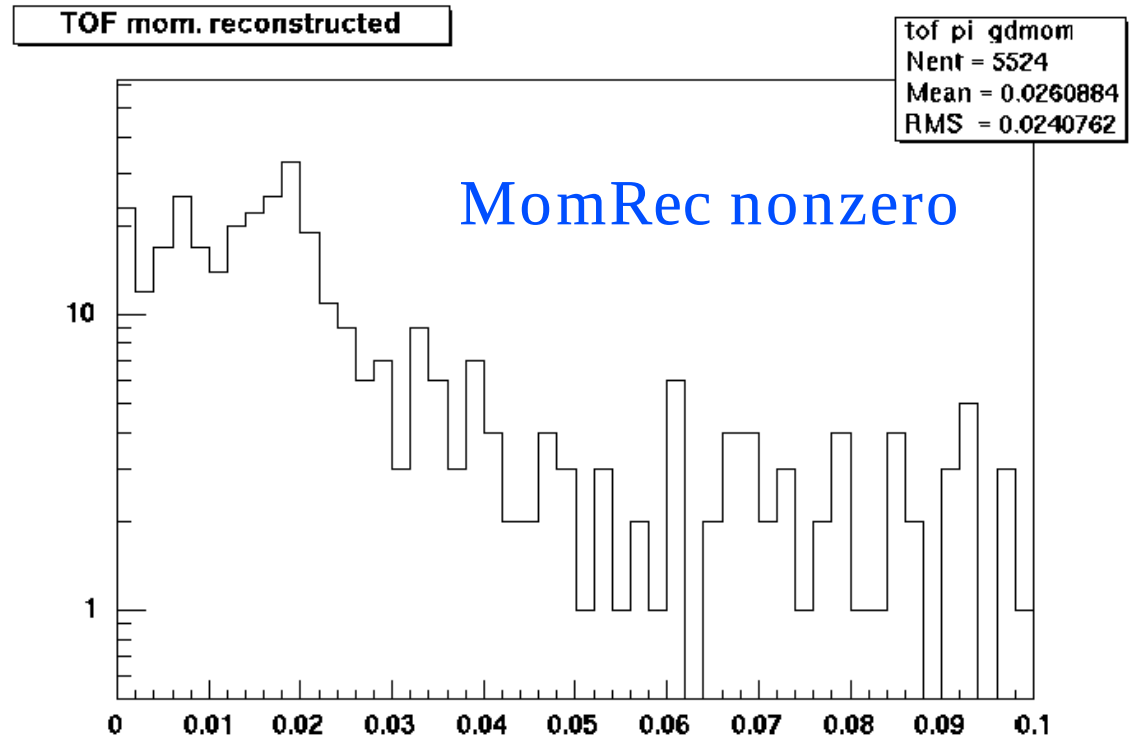


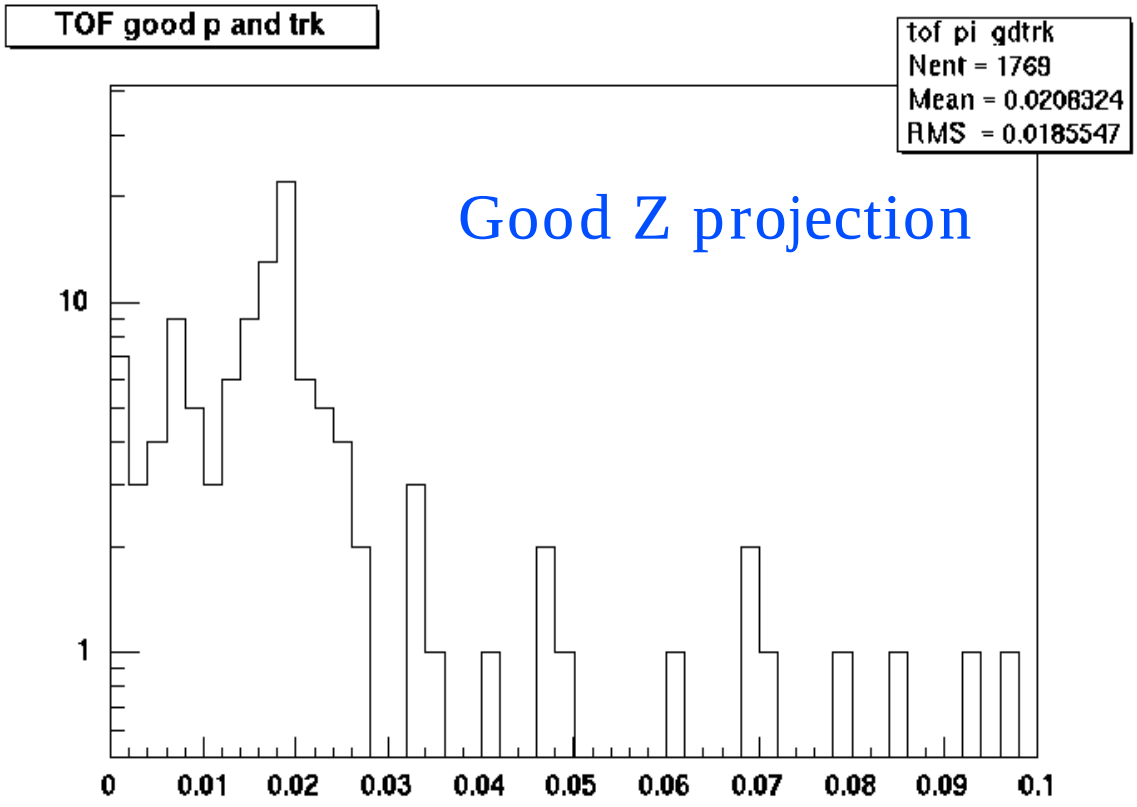
Mass^2 From TEC γβ



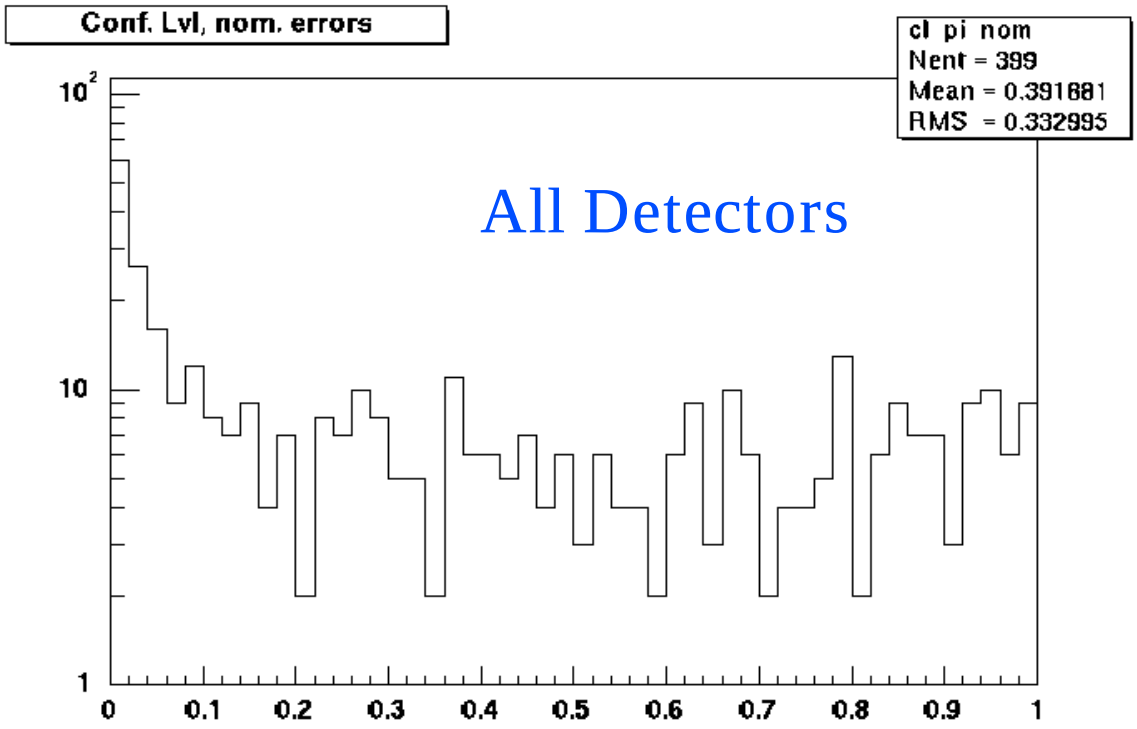


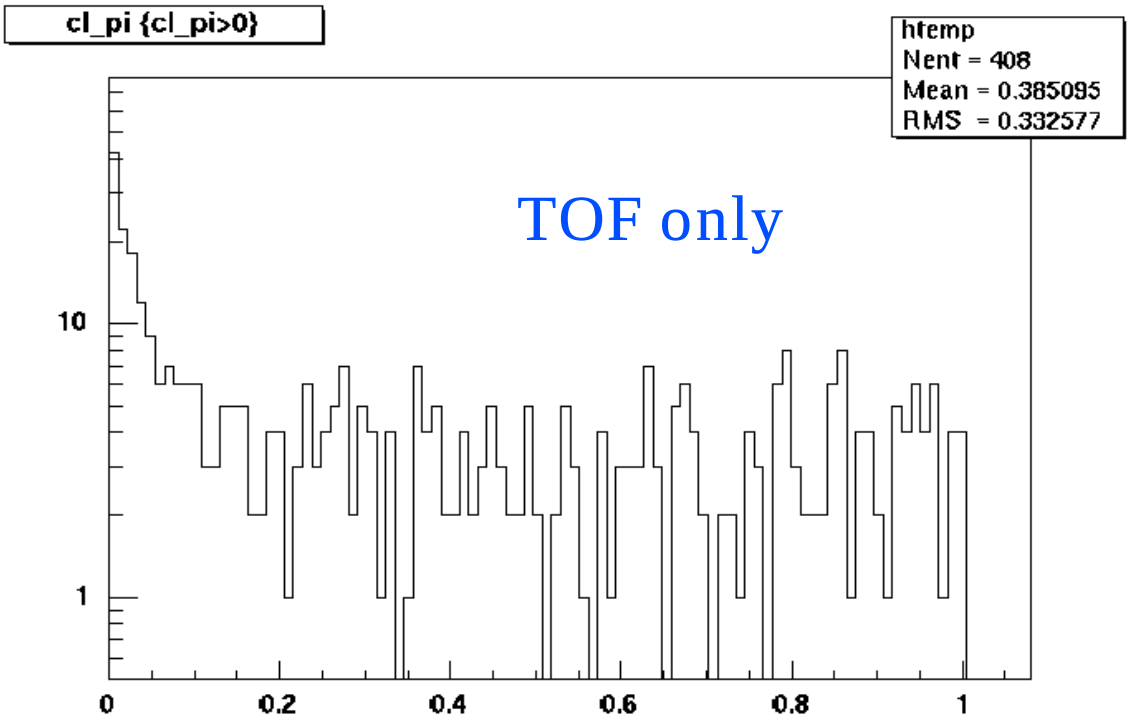
Mass^2 TOF with track cuts



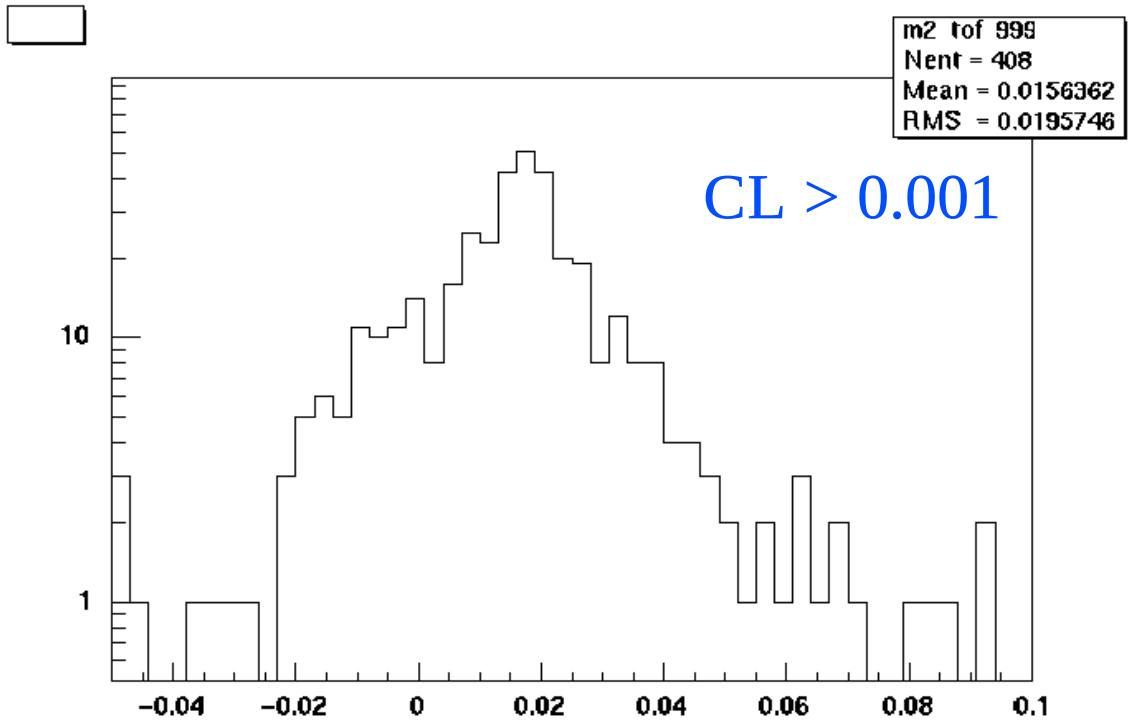


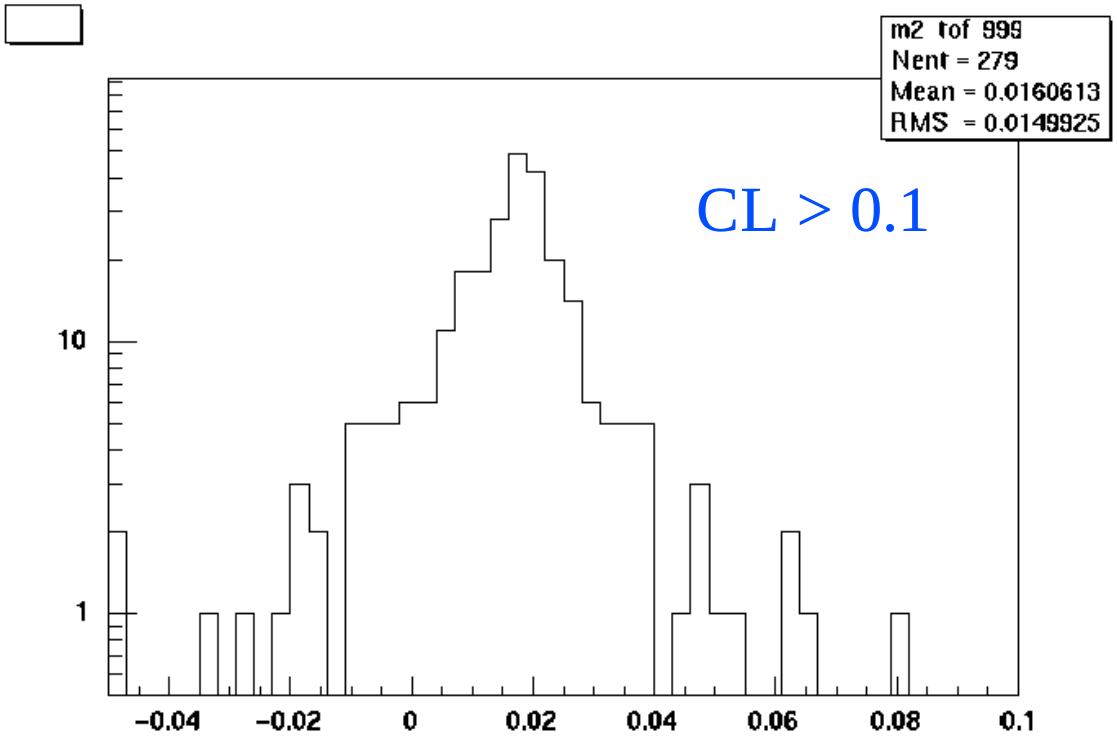
Pion Confidence Levels



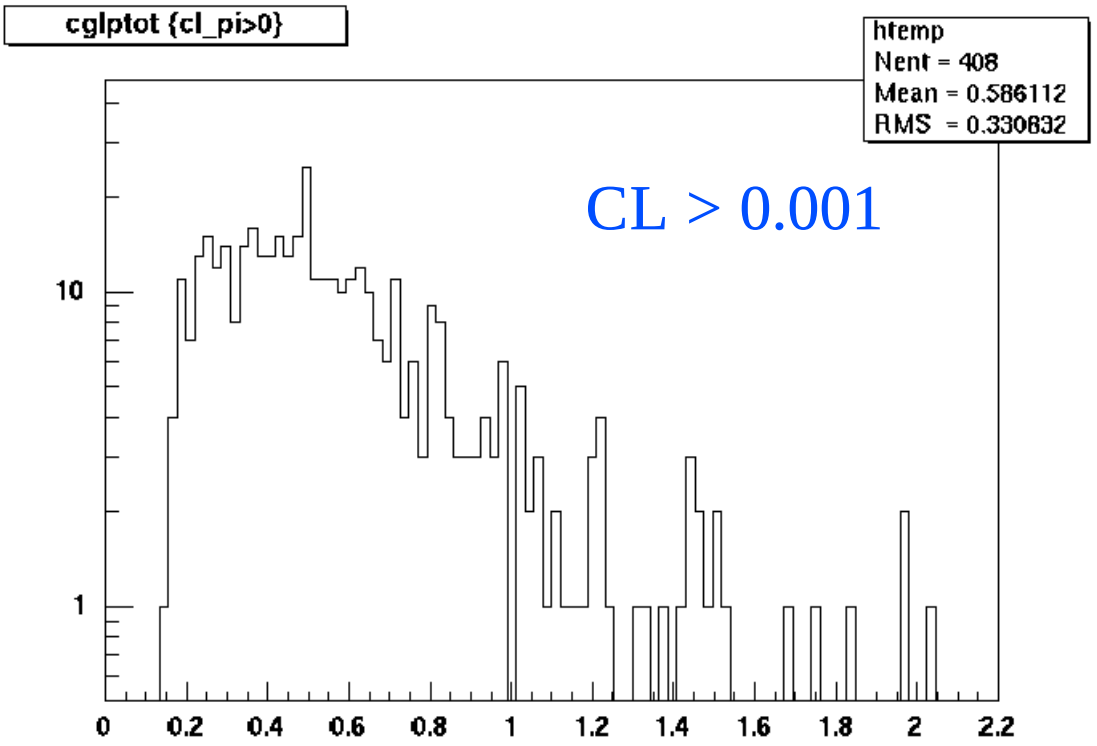


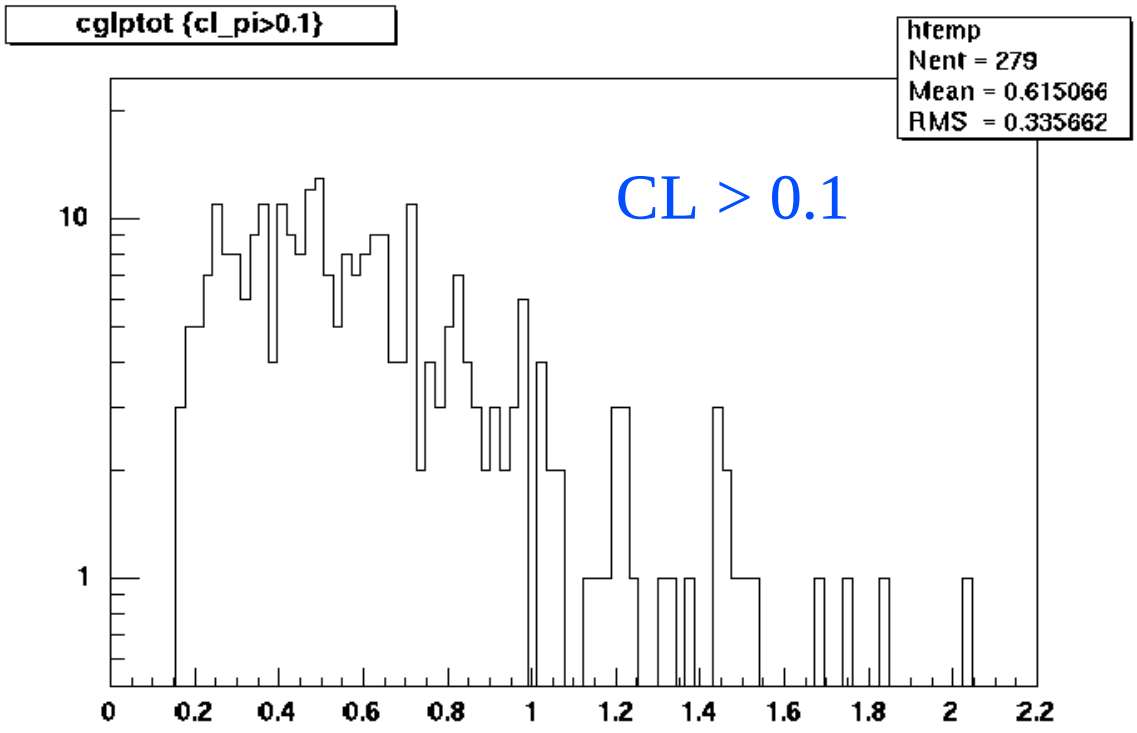
Mass^2 TOF with CL cuts





Recon. Mom. for CL cuts



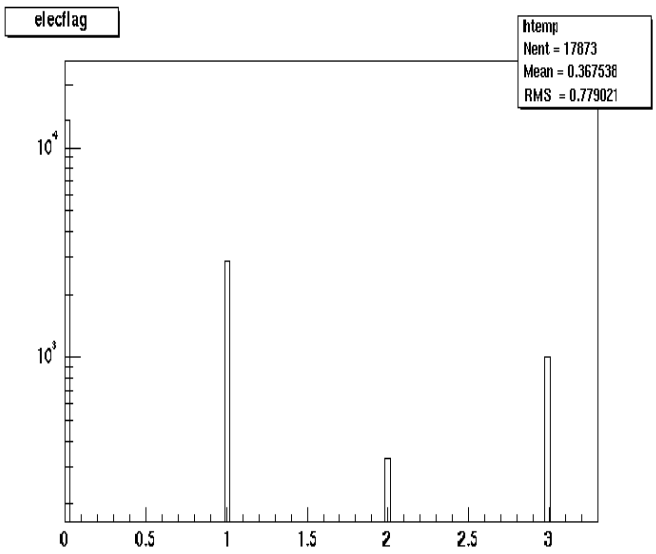


Electron Candidate Screening

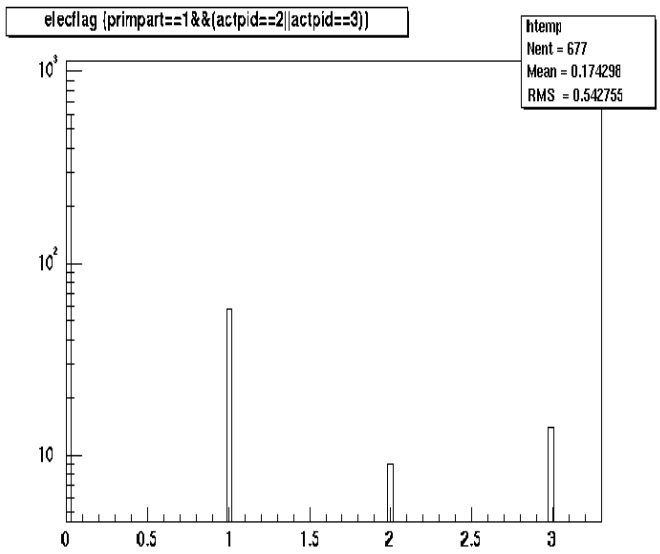
Bit Pattern Flag for Cuts on:

- EMCal (E-p) / p < cut (here 0.2)
- TEC (dE / dx-dE / dx(e) / dE / dx(e)) < cut (here 0.2)
- RICH Npmt for ring >= cut (here 3)
- RICH χ^2 for ring <= cut (here 4.0)
- RICH Rdisp <= cut (here 4.0)

All Tracks



Primary Electrons

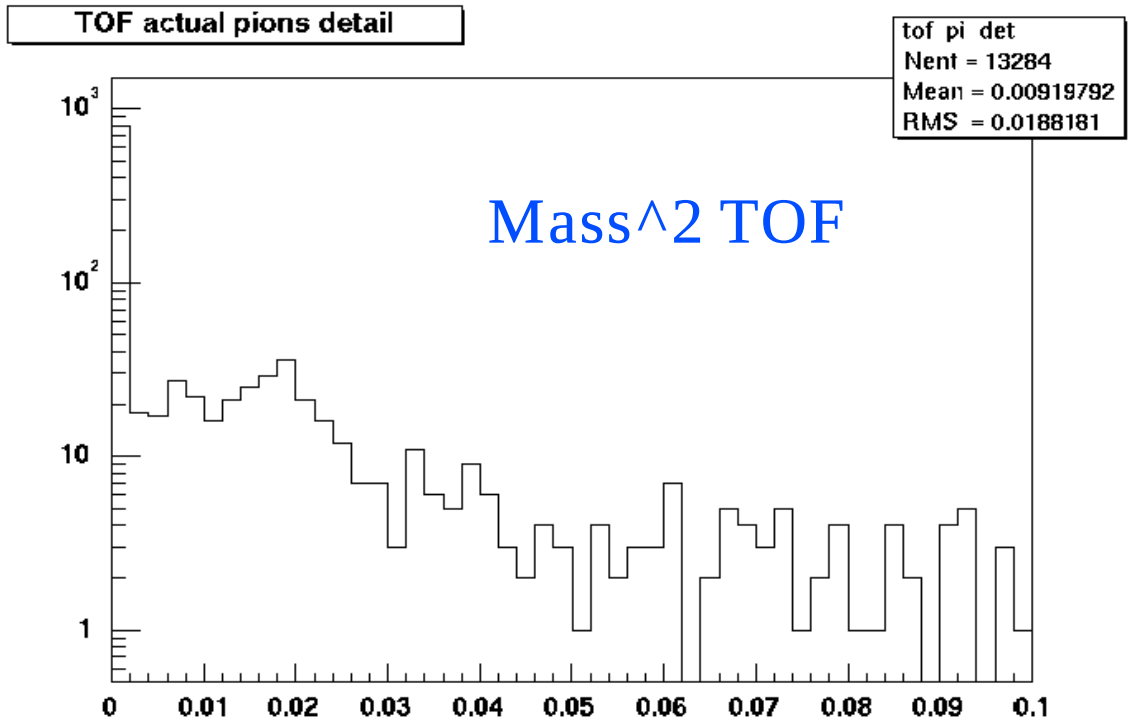


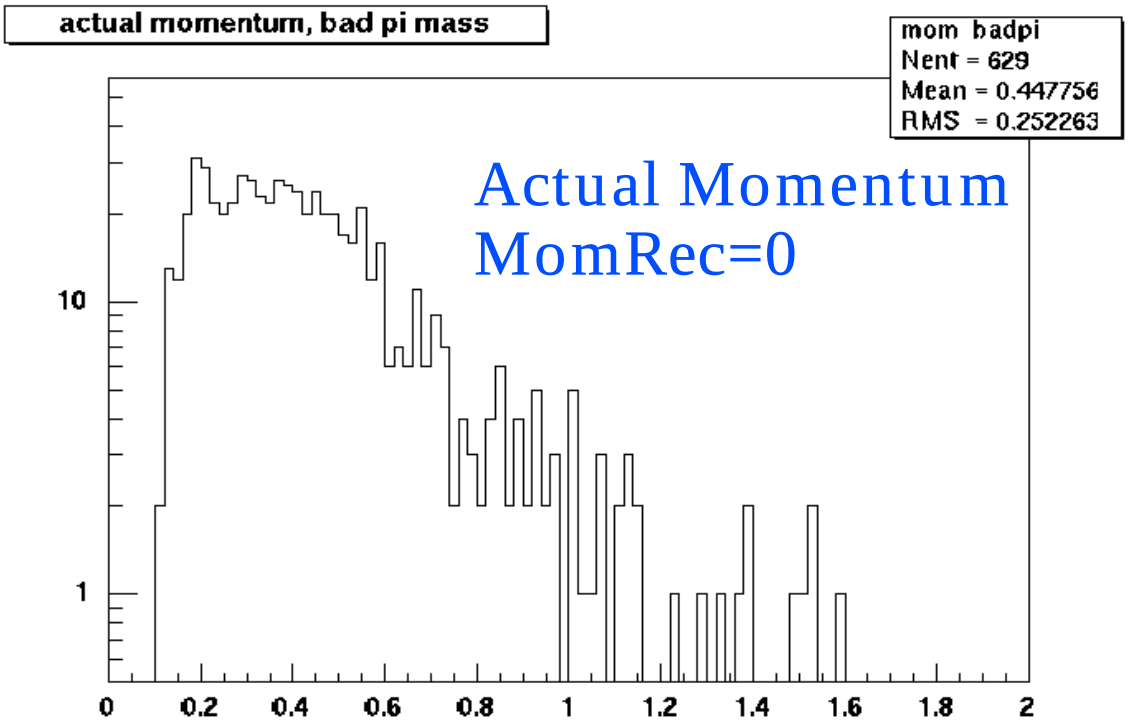
Debugging---mCglPidEval

Creates ROOT Ntuple with:

- PISA track ID for dominant contrib.
  inner track, TEC, TOF, EMCal
- Dom. Contrib. PID
- Projections
  reconstructed and real
    Z vertex, Theta, Phi
  projected and detector
    hit positions at EMCal and TOF
- PID input info
  Detector output
  Projected flight distances
- mCglPid Output
  Mass^2 and errors
  Confidence Levels for π, K, p
  Electron Flag

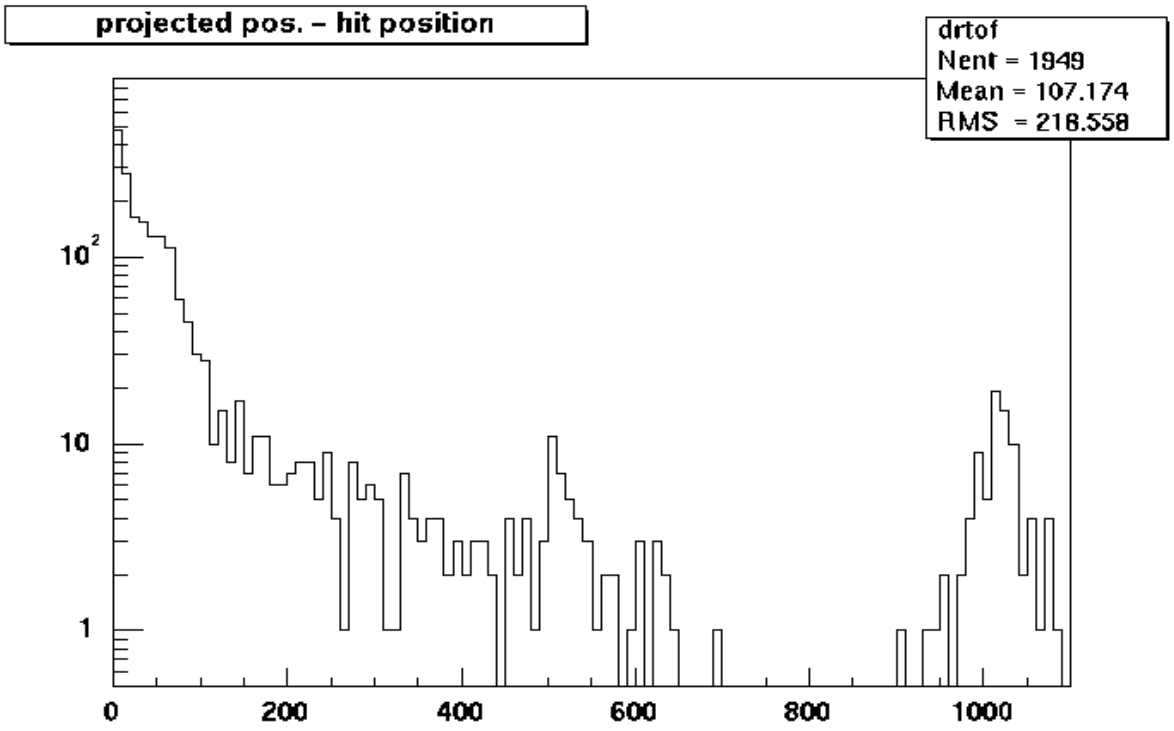
Tracks of primary pions





Code Debugging with PID

Distance between projected TOF positon and actual position



Things to do:

- Understand Mass^2 spectra
  - Better statistics
  - Work together with detector people
  - Decouple tracking from detector response
    - (implement detector dom. contrib.)
- Understand Mass^2 errors
  - What factors dominate
  - CL trends
- Reconcile mCglProjection with DC projection, and improve modelling of detector geometry for intersection
- Implement PID Probability
  - require reloop over particles to determine particle ratios